THE DISTRIBUTION OF PINACEAE IN AND NEAR NORTHERN NEVADA

William B. Critchfield and Gordon L. Allenbaugh

Introduction

More than 50 years ago G. B. Sudworth (1913) observed: "Contrary to popular belief, our present knowledge and published records of the geographic range of North American trees is still very incomplete." This statement remains true today for much of the interior West, particularly the semi-arid Great Basin. Although the botanical exploration of this region began over a century ago, information about the distribution of native trees is still sketchy and inaccurate. This is true even of the Pinaceae, although most of the trees in this family are readily identifiable and are among the most conspicuous elements of the vegetation.

One reason for this lack of information is the unique topography of the Great Basin, which is made up of many smaller basins with interior drainage. Tree growth is mostly confined to the numerous isolated mountain ranges, called basin ranges. These ranges, usually oriented north and south and typically much longer than wide, occupy about half the total area of the Great Basin (Fenneman, 1931). The intervening valleys, which sometimes contain playas or playa lakes, are usually treeless. Many of the basin ranges are rather inaccessible, and plant collections from some of them are few or nonexistent.

Throughout much of the Great Basin three pines, *Pinus monophylla, P. flexilis,* and *P. aristata,* are among the dominant elements of the montane vegetation (Billings, 1951). Toward the north and northwest, however, they disappear and other members of the Pinaceae appear as outliers of the coniferous forests that border the northern Great Basin. This transitional area is the region covered by this paper (fig. 1). It includes much of the northern Great Basin and a physiographically similar portion of the Snake River drainage (southeastern Idaho and adjoining parts of Oregon and Nevada). This paper reports several extensions of species ranges, summarizes what is currently known about the distribution of the Pinaceae in this region, and reviews the events that may have brought about the present "insular" distribution of these conifers.

Sources of Information

The first detailed maps of these conifers were those of Sudworth (1913; 1916; 1918). His original working maps, which are on file at the Washington Office of the U. S. Forest Service, have been helpful in establishing the sources of his information. Revised versions of Sudworth's maps were published by the Forest Service in 1938 (Munns, 1938). Recently, revised distribution maps of all of the Pinaceae of this region have been published (Fowells, 1965; Critchfield and Little, 1966).

The Idaho ranges of these species have also been mapped by Johnson (1966).

The principal descriptions of the distribution of the Pinaceae in this region are those of Billings (1954) and Little (1956). Parts of the region were covered by Sudworth (1908) and Holmgren (1942).

Unpublished sources of information include field observations and specimens in several herbaria. Our collections are not cited in the text, but the localities that we visited are indicated in Fig. 1. Specimens from these localities are in the conifer herbarium of the Institute of Forest Genetics, Placerville, California (IFGP: Critchfield, 1966), and some of them are duplicated in these herbaria: US, USFS, and MSC. Several government agencies which have supplied us with information and collections are cited in the text by these abbreviations: Forest Service, U. S. Department of Agriculture (FS); Bureau of Land Management, U. S. Department of the Interior (BLM); and Nevada State Fish and Game Commission (NFG).

The contributions of several individuals and agencies are referred to in the text. We also wish to thank J. R. Griffin, E. L. Little, Jr., and J. L. Jenkinson for their help.

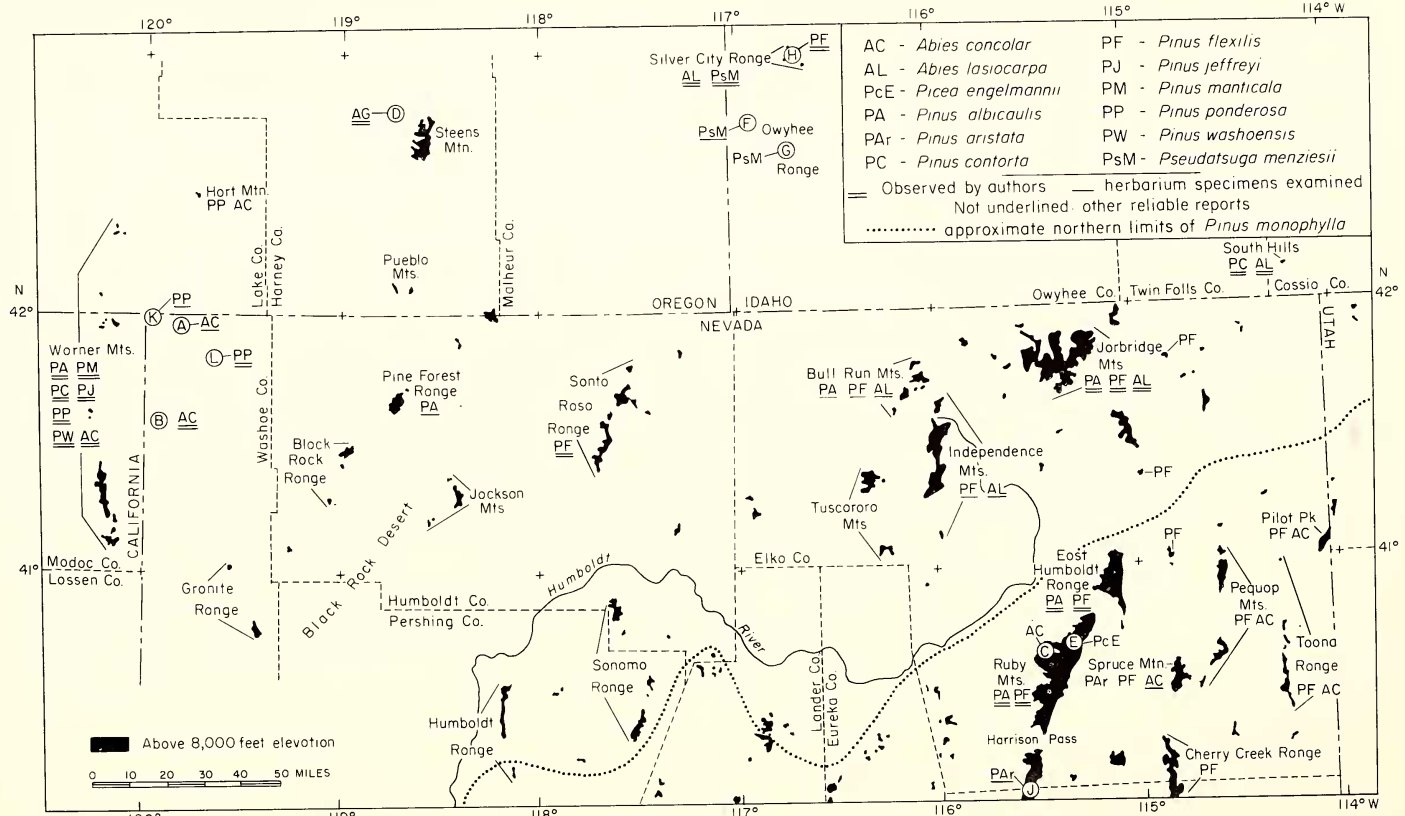
The Distribution of Species

Abies concolor (Gord. & Glend.) Lindl. White fir. Both California white fir and Rocky Mountain white fir extend into widely separated parts of this region. The former is sometimes called *A. lowiana* (Gord.) A Murr. or *A. concolor* var. *lowiana* (Gord.) Lemm. to distinguish it from Rocky Mountain white fir, which extends from the southern Rocky Mountains into the eastern and southern parts of the Great Basin. These two geographically separated strains differ in morphology, but their status as separate taxa is not universally recognized.

It has been known for many years that California white fir grows in the Warner Mountains of northeastern California and southern Oregon and in the nearby Hart Mountain area of southern Oregon (Sudworth, 1908). White fir is one of the commonest trees in the mixed-conifer forest of the Sierra Nevada and southern Cascade Mountains, and the forests of the Warner Mountains are an impoverished eastward extension of this vegetation type.

East of the Warner Mountains, several unreported outliers of white fir grow in a range of low mountains in the northwestern corner of Nevada. These mountains do not have a generally accepted name now, but in the past they have been called the East Warner Mountains. This range is separated from the Warner Mountains by Surprise Valley and from the mountains to the east by Long and Coleman Valleys.

Near the northern end of the range, just west of Coleman Valley and a few miles south of the Oregon border, are two fairly extensive creek-bottom stands of white fir about two miles apart (fig. 1A: 41°57.7′ N Lat, 119°50.0′ W Long, and 41°56.4′, 119°49.5′). They are growing at


AC - Abies concolor
AL - Abies lasiocarpa
PcE - Picea engelmannii
PA - Pinus albicaulis
PAr - Pinus aristata
PC - Pinus contorta
PF - Pinus flexilis
PJ - Pinus jeffreyi
PM - Pinus manticala
PP - Pinus ponderosa
PW - Pinus washoensis
PsM - Pseudatsuga menziesii
Observed by authors — herbarium specimens examined
Not underlined: other reliable reports
approximate northern limits of Pinus monophylla
Above 8,000 feet elevation
0 10 20 30 40 50 MILES
120° 119° 118° 117° 116° 115° 114° W
N 42°
41°
OREGON
IDAHO
NEVADA
CALIFORNIA
UTAH
Silver City Range PF AL PsM
Steens Mtn. AG D
Owyhee PsM F
Ronge PsM G
Hart Mtn. PP AC
Lake Co.
Harney Co.
Pueblo Mts.
Malheur Co.
Worner Mts. PA PM PC PJ PP PW AC
K PP
A AC
L PP
B AC
Washoe Co.
Pine Forest Range PA
Block Rock Ronge
Jackson Mts
Black Rock Desert
Modoc Co.
Lossen Co.
Gronite Ronge
Humboldt Co.
Pershing Co.
Sonto Roso Ronge PF
Humboldt River
Sonomo Ronge
Humboldt Ronge
Elko Co.
Lander Co.
Eureka Co.
Tuscororo Mts
Bull Run Mts. PA PF AL
Independence Mts. PF AL
Jorbridge Mts PA PF AL
PF
South Hills PC AL
Owyhee Co.
Twin Falls Co.
Cossio Co.
Pilot Pk PF AC
East Humboldt Ronge PA PF
AC C E PcE
Ruby Mts. PA PF
Spruce Mtn. PAr PF AC
Pequop Mts. PF AC
Toono Ronge PF AC
Harrison Pass PAr J
Cherry Creek Ronge PF

5500–6800 ft along spring-fed streams which flow eastward into Coleman Valley (BLM). J. C. Fremont's first expedition may have passed within sight of these stands when it entered Nevada through Coleman Valley early in 1844. The first and only botanists known to have visited them are F. V. Coville and J. B. Leiberg, who collected white fir in this vicinity in 1896 (Coleman Valley, *Coville & Leiberg 119,* US).

Twenty-five miles to the south is a third and much smaller outlier growing around a spring at the head of Forty-nine Canyon (fig. 1B: 41°35.2′ N Lat, 119°54.9′ W Long, 6000 ft elev.). This grove, also reported to us by BLM, is within sight of Nevada State Highway 8A. It consists of 10 large trees and several times as many seedlings and saplings. The largest trees range up to 4 ft in diameter at breast height, and are at least 200–300 years old.

These outliers of California white fir are separated by more than 200 miles from the northwestern limits of Rocky Mountain white fir (fig. 1). The latter is present in the higher ranges of east-central and southern Nevada (Billings, 1954; Little, 1956), and extends north into southern Elko County. There it grows on Pilot Peak (NFG, BLM), in the Toana Range (NFG; A. H. Holmgren, pers. comm.), in the Pequop Mountains (NFG), and on Spruce Mountain (*Zavarin 723–737,* IFGP). A single stand in the northern Ruby Mountains (fig. 1C) is located at an elevation of about 8500 ft in Seitz Canyon, at 40°39′ N Lat, 115°28′ W Long (FS).

Older distribution maps erroneously show white fir in many of the mountain ranges of northern Elko Co., south-central Idaho, and northwestern Utah (Sudworth, 1916; and Munns, 1938). The most recent map of the species still shows it on one of these ranges—the South Hills, in Idaho (Fowells, 1965). The presence of white fir north of southern Elko Co. has not been verified, and this error may have originated from confusion between this species and *Abies lasiocarpa.*

Abies grandis (Dougl.) Lindl. Grand fir. The typical form of grand fir, which ranges from northern California to western Montana, does not enter or even approach the Great Basin. In the southern part of its range, however, grand fir appears to intergrade with white fir through a broad zone extending from northwestern California to western Idaho. This intermediate form extends into the northwestern Great Basin. The only representative of the Pinaceae in the southeastern corner of Oregon, it is present in a single locality on the west slope of Steens Mountain (fig. 1D).

Although this stand is not shown on distribution maps or listed in floras, its existence has been known for many years. F. V. Coville visited it in 1896 (*Coville 598,* US). An early geological report on Steens Mountain probably referred to this stand in the following statement: "A few pines, firs, junipers, and cottonwoods grow in the deep canyons on its west slope" (Russell, 1903). In another geological report Waring (1909),

Fig. 1. The distribution of Pinaceae in northern Nevada and adjacent areas. Circled letters A to L are localities mentioned in the text.

commenting on the remarkable absence of timber on this range, noted as one of the exceptions "a small group of firs in one canyon." In 1938, O. V. Matthews collected wood samples of the fir, which he called *A. concolor* (Anon, 1944).

The Steens Mountain fir grows along the banks of Big and Little Fir Creeks and on the north-facing slopes of their canyons. The stand extends a short distance below the point where they join to form a stream known as Mud or Fir Canyon Creek. The main stand ranges in elevation from 5900 to 6200 ft, and covers an estimated 30–40 acres (42°47′ N Lat, 118°43′ W Long). About a mile to the south is an outlier consisting of a few trees (BLM).

The Steens Mountain stand is nearly equidistant from *A. concolor* in south-central Oregon and the intermediate populations of the Blue Mountains to the north. We have grouped it with *A. grandis* because it is morphologically similar to the Blue Mountains fir, which at present is commonly classed with *A. grandis* (Fowells, 1965).

Abies lasiocarpa (Hook.) Nutt. Subalpine fir. This high-elevation tree extends westward from the Wasatch Mountains into the Great Basin at least as far as the Deep Creek Range, just southeast of the region considered here (McMillan, 1948). It is absent from the isolated ranges in the northern Great Basin, but in the northern part of Elko Co. it is one of the commonest trees in the mountains that form the divide between the Great Basin and the Snake River drainage. It grows in the Bull Run and Jarbidge Mountains, and in the Independence Mountains it extends at least as far south as the Jack Peak area at 41°30′ N Lat (FS). Subalpine fir is also a common tree on two ranges north of this divide—the Silver City Range and the South Hills (fig. 1). From the South Hills this fir extends eastward to the Wasatch and Rocky Mountains.

Abies lasiocarpa may be the fir that Sereno Watson encountered in the extreme northwestern corner of Utah on King's 1867–68 Fortieth Parallel Expedition. Watson crossed the northern end of the Goose Creek Mountains, which extend southwest from this corner of Utah into Nevada. In some of the moist canyons, he found a tree that he called *A. grandis* (Watson, 1871). His description does not fit any of the western firs, but *A. lasiocarpa* is the only fir on the nearby ranges, including the Albion Mountains (FS) and South Hills to the north and the Raft River Mountains to the east (Preece, 1950).

A report of *A. lasiocarpa* on Steens Mountain (Bailey, 1936) is probably a mistake. Bailey's table 7 lists it in the Hudsonian zone of this range, but in the text he notes that the aridity of Steens Mountain eliminates all of the trees characteristic of the Hudsonian zone.

Picea engelmannii Parry. Engelmann spruce. This species—the only spruce of the northern Great Basin—is common north and east of this region. It extends west from the Rocky Mountains to the Raft River Mountains (Preece, 1950) and the Albion Mountains (FS). It stops

short of the South Hills in southern Idaho, although it is often shown there (Munns, 1938; Johnson, 1966; Fowells, 1965). Farther south, another salient extends westward from the Wasatch Mountains to the Deep Creek Mountains (McMillan, 1948) and the nearby high ranges of eastern Nevada (Billings, 1954; Little, 1956).

In the region treated here, Engelmann spruce is definitely known in only one locality, the head of Thorpe Creek in the northern Ruby Mountains (FS). This stand is located at an elevation of 9–10,000 ft at 40°42′ N Lat, 115°20′ W Long (fig. 1E). There may be other small outliers in this range, however. Sereno Watson, the first botanist to visit the Ruby Mountains, noted that "in some of the high western canyons there is a dense growth of *Abies* [*Picea*] *engelmannii*" (Watson, 1871). He traveled extensively in the southern and central Ruby Mountains, and his routes are shown on the map accompanying his account. Since the northernmost point that Watson visited was nearly 10 miles south of Thorpe Canyon, the stands of Engelmann spruce that he found may have been overlooked since 1868.

Watson called the Ruby Mountains the "East Humboldt Mountains." The later change of names has caused a great deal of confusion, since two other ranges in northern Nevada are sometimes called the East Humboldt Mountains at present. One of them, a northward extension of the Ruby Mountains, was called the Clover Mountains by Watson. The other range, located east of the Humboldt Mountains in Pershing County, is called the East Humboldt or East Range. (Watson referred to it as the Pah-Ute Mountains.) A Pershing County outlier of *P. engelmannii* shown by Munns (1938) can probably be attributed to this change in place names.

Engelmann spruce is also sometimes shown in the Silver City Range (Munns, 1938; Fowells, 1965). This southern Idaho occurrence has not been verified, and is probably in error.

Pseudotsuga menziesii (Mirb.) Franco. Douglas fir. Of the two generally recognized geographic races of this species, only the Rocky Mountain Douglas fir (var. *glauca* (Beissn.) Franco) extends into this region. The Pacific Douglas fir (var. *menziesii*) reaches its eastern limits west of the Warner Mountains.

Rocky Mountain Douglas fir, like Engelmann spruce, extends west from the Wasatch and Rocky Mountains in two salients. In the north it reaches the Raft River Mountains (Preece, 1950) and the Albion Mountains (FS). Like Engelmann spruce, Douglas fir stops short of the South Hills, although it is generally mapped there (Sudworth, 1918; Fowells, 1965; Johnson, 1966). The southern salient extends westward from the Wasatch Mountains to the Deep Creek Range (McMillan, 1948) and the higher ranges of east-central Nevada (Billings, 1954; Little, 1956). Unlike Engelmann spruce, Douglas fir is not known to extend north into Elko Co., although Sudworth (1918) and Munns (1938) showed it

in the Ruby Mountains on the basis of an unpublished report accompanying Sudworth's original working map of this species ("Ruby Mountains at Harrisons Pass, scarce").

The only known stands of Douglas fir in this region are in southwestern Idaho. It is a common tree in the Silver City Range, sometimes considered part of the Owyhee Range. Two other sizable but previously unreported outliers are present in the Owyhee Range to the south (BLM; fig. 1F, G). Around South Mountain (42°45′ N Lat, 116°55′ W Long) this species is distributed rather widely, with a much smaller patch (100–200 acres) about 12 miles to the southeast (42°38′, 116°42′).

Douglas fir has also been reported in the mountains of northern Elko Co. (Billings, 1954; Little, 1956; Fowells, 1965), but we consider this occurrence doubtful. These reports are based on specimens collected on Cobb Creek and Merritt Mountain, south and northeast of Mountain City (*Nichols & Lund 373, 453,* RENO). However, Forest Service and other local informants are unanimous in stating that they have never seen Douglas fir growing in nature anywhere in these mountains.

Pinus monticola Dougl. Western white pine. This pine is widely distributed north and west of the Great Basin. It enters the region considered here only at its western edge, in the Warner Mountains. It was first encountered on the higher peaks of this range by C. Hart Merriam in 1896 (Sargent, 1897).

Pinus albicaulis Engelm. Whitebark pine. This pine is characteristic of high elevations, extending to timberline, in the high mountains west and north of this region and in the Warner Mountains. It is also unexpectedly common in several mountain ranges of northern Nevada. Its presence there was not reported until recently, although it has occasionally been collected in this region during the past 70 years. One reason that *P. albicaulis* has been generally overlooked is its close similarity to *P. flexilis,* which is much more widely distributed in the Great Basin region. The two species differ greatly in their cones, but the rather fragile cones of *P. albicaulis* are nearly always destroyed by birds or small mammals as they approach maturity or soon thereafter. Vegetatively these two white pines are much alike; a reported difference in the number and distribution of resin canals in the needles of trees in southern Montana and western Wyoming (Ericson, 1964) does not hold true in Canada (Brayshaw, 1965) or northern Nevada.

The presence of whitebark pine in the higher parts of the Warner Mountains has been known since C. H. Merriam found it there in 1896 (Sargent, 1897). Sudworth (1913) and Munns (1938) did not record it elsewhere in this region. Their maps show it in two localities to the east, the Albion Mountains of Idaho and the Wasatch Mountains east of Salt Lake City, but we have been unable to verify either of these occurrences. Holmgren (1942) did not list whitebark pine in his flora of northeastern Nevada. Billings (1954) reported "vegetative specimens (probably authentic) . . . from . . . Pine Mountain in Humboldt County."

We have not been able to locate a Pine Mountain in Humboldt Co., but there is a Pine Mountain in northern Elko Co. (41°46′ N Lat, 115°37′ W Long). Authentic *P. albicaulis* has been collected there (*Hitchcock 1177,* US), and this may be the locality to which Billings referred.

The first report that whitebark pine is widely distributed in northern Nevada was that of Little (1956). He recorded it in the Pine Forest Range of Humboldt Co., and the Jarbidge Mountains, Ruby Mountains, and Pine Mountain, all in Elko Co. In addition to these areas, it is now known to occur in the East Humboldt Range and the Bull Run Mountains, both in Elko Co. (fig. 1).

Whitebark pine is the only pine of the Pine Forest Range. This stand is far removed from any other stand of this species—at least 70 miles east of the Warner Mountains and nearly twice that distance west of the nearest stands in northern Elko Co. Presumably this is the pine referred to in an early geological report: "The Pine Forest Mountains are covered over a limited area with a forest of yellow pine, from which this range derives its name" (Russell, 1885). Whitebark pine was collected here in 1896 (*Streator 1015,* US) and 1901 (*Griffiths & Morris 225,* US), but these collections were overlooked for more than 50 years. The pine of the Pine Forest Range was identified as "*Pinus flexilis* (?)" by Taylor (1912), a zoologist who did extensive field work in this area. His identification was based partly on foliage, "no cones being at hand," and partly on geographic and zonal considerations. One of Taylor's photographs of this pine was included in Hall's comprehensive treatment of the mammals of Nevada, captioned "limber pines in the Pine Forest Mountains" (Hall, 1946, plate 2b). The identification of this pine as *P. albicaulis* by Little (1956) is the first mention in the botanical and forestry literature of this or any other pine in these mountains. The Pine Forest stand was visited a few years ago by A. Cronquist, who noted that the pines are confined to the granitic rocks that make up the core of this range (pers. comm.).

In the Jarbidge Mountains of northern Elko Co., *P. albicaulis* is the only common pine; *P. flexilis* is present but rare. In this region *P. albicaulis* reaches much lower elevations than it does at the same latitude in California. It grows from as low as 6400 ft in the valley of the Jarbidge River to above 10,000 ft in the Jarbidge Mountains to the east. It is known to extend as far northeast as Pole Creek, at about 41°55′ N Lat, 115°15′ W Long (*Nelson & McBride 2070,* US, A). Its range in northern Elko Co. has recently been extended as far west as the Bull Run Mountains, where it was collected by S. A. Scott (FS) at 41°42′ N Lat, 116°08′ W Long, 8600 ft elevation (*Scott,* 1965, IFGP). This species has not yet been reported from the Independence Mountains, a higher southward extension of the Bull Run Mountains.

South of the Humboldt River *P. albicaulis* appears in the connected Ruby and East Humboldt Ranges. Around Angel Lake, at 8400 ft in the East Humboldts, it is intermingled with *P. flexilis*. In the Ruby Moun-

tains we have seen it at the head of Lamoille Canyon, a U-shaped glaciated valley which penetrates deeply into the northern part of the range. Below 8500 ft we saw only *P. flexilis,* but above that elevation *P. albicaulis* is the more common of these two pines. Both species are still present at 10,000 ft on the crest of the range south of Lamoille Canyon. *P. albicaulis* extends at least as far south as Green Mountain, at 40°23′ N Lat (FS), but it has not yet been reported in that part of the Ruby Mountains south of Harrison Pass. At Green Mountain it reaches its southermost known limit in the region east of the Sierra Nevada.

Pinus flexilis James. Limber pine. This pine, one of the characteristic trees of the basin ranges, is present on the higher mountains throughout most of Nevada except the extreme western part (Billings, 1954; Little, 1956). Holmgren (1942) reported that it is frequent in the higher mountains of Elko Co. Most distribution maps (Sudworth, 1913; Munns, 1938; Little, 1949) show it in the mountains of Elko Co. and in the Warner Mountains of California.

Limber pine is widespread in the eastern part of this region. It was collected in the Ruby Mountains by Sereno Watson nearly a century ago ("East Humboldt Mountains," *Watson 1113,* US). Holmgren (1942) noted limber pine on Spruce Mountain, at the southern end of the Pequop Mountains (fig. 1). Here, according to R. D. Wright (pers. comm.), it is mixed with bristlecone pine *(P. aristata)* in an extensive forest that extends from 9000 ft to the top of the mountain.

In the northern part of Elko Co., limber pine is present in the Independence Mountains (*Kinnaman 21,* FS), Bull Run Mountains (*Scott,* 1965, IFGP), Pine Mountain (*Hitchcock 1176,* US), and the Jarbidge Mountains, where it is quite rare. We found only two small groves in the valley of the Jarbidge River, one growing on a rocky outcrop on the canyon wall (41°48′ N Lat, 115°24′ W Long), and the other on the bank of the river (41°55′, 115°25′).

Elsewhere in Elko Co. limber pine is present in most of the higher mountains (fig. 1). For this information we are indebted to L. W. Hoskins (NFG, pers. comm.).

North and east of this corner of Nevada the distribution of limber pine is sporadic. It is absent from the South Hills, but is frequent at higher elevations in the Raft River Mountains (Preece, 1950), and is present in the Albion Mountains (Johnson, 1966). In the Silver City Range of southwestern Idaho, only two trees of this species have been found (fig. 1H). They are growing near the top of War Eagle Mountain at 8100 ft elevation, 42°59′ N Lat, 116°40′ W Long (W. H. Baker, pers. comm.).

In the western half of this region, limber pine is present only in the Santa Rosa Range of eastern Humboldt Co. It does not appear to have been reported from this range before, although it is not uncommon. It grows in scattered patches near the crest of the mountains.

Limber pine is shown in the Warner Mountains on many distribution

maps of this species. This error can be attributed to an early misidentification of some other five-needled pine, probably western white pine. Excerpts from a 1903 report by Filibert Roth on the Warner Mountains Forest Reserve, which are on file at the Washington Office of the Forest Service, mention the appearance of limber pine with lodgepole pine at 7000 ft. It is not likely that Roth confused whitebark and limber pines, since he noted elsewhere that whitebark pine is common above 7500 ft. Western white pine, the only other white pine present in the Warners, is a more likely candidate for this persistent but erroneous extension of limber pine's range into northern California.

PINUS ARISTATA Engelm. Bristlecone pine. Like limber pine, bristlecone pine is a characteristic tree of the basin ranges, but it is neither as common nor as widespread as limber pine. From the southern Rocky Mountains and the mountains of southern Utah it extends west to the Deep Creek Range (McMillan, 1948) and the higher mountains of eastern and central Nevada (Billings, 1954; Little, 1956). In northern Nevada it is known to occur on Sherman Mountain, at the southern end of the Ruby Mountains (fig. 1J; Little, 1956), and on Spruce Mountain in southern Elko Co. (Holmgren, 1942). On these two mountains bristlecone pine reaches its northwestern known limits. It was first collected in the Ruby Mountains— presumably on Sherman Mountain—by Watson in 1868 ("East Humboldt Mountains," *Watson 1112,* US), and it has since been collected on Sherman Mountain by others (*Hitchcock & Martin 5686,* POM). On Spruce Mountain, the upper slopes are occupied by an extensive forest of this species and limber pine.

Bristlecone pine was also mapped in the East Humboldt Range of Pershing Co. by Munns (1938). This erroneous range extension can be attributed to Watson's specimen from the "East Humboldt Mountains," later called the Ruby Mountains.

PINUS MONOPHYLLA Torr. & Frem. Singleleaf pinyon. This species is the commonest member of the Pinaceae throughout much of the Great Basin. Mixed with juniper (usually *Juniperus osteosperma* (Torr.) Little), it occupies a broad woodland belt on the lower slopes of the mountains in the central and southern Great Basin. In north-central Nevada, it reaches its known northern limits south of the Humboldt River (fig. 1), although older maps often show it north of the river in Elko Co. (Sudworth, 1913; Munns, 1938; Little, 1949). East of the Nevada-Utah border it extends much farther north to the Raft River Mountains (Preece, 1950) and southern Idaho (Johnson, 1966). Its range in Nevada is shown in detail by Critchfield and Little (1966).

PINUS CONTORTA Dougl. Lodgepole pine. Two geographic races of this widespread and variable species enter this region at places more than 300 miles apart. The open-cone Sierra Nevada-Cascade race, which has been called *P. contorta* ssp. *murrayana* (Balf.) Critchfield (Critchfield, 1957), grows in the Warner Mountains. The Rocky Mountain race (*P. contorta* ssp. *latifolia* (Engelm.) Critchfield), which often has serotinous

cones, occurs in the mountains of southern Idaho as far west as the South Hills, where it is a common tree. In the South Hills area lodgepole pine stops a few miles short of the Nevada border (FS), although it is sometimes shown in the northeastern corner of that state (Munns, 1938). Nor does this species extend south from Idaho to the Raft River Mountains of northwestern Utah (Preece, 1950; FS), although it is shown there on the most recent maps (Fowells, 1965; Critchfield and Little, 1966).

Pinus jeffreyi Grev. & Balf. Jeffrey pine. This primarily California species extends into this region only in the Warner Mountains. Although Sudworth (1908) recorded Jeffrey pine "at the sources of the Pitt [Pit] River," which originates in the Warners, it was not shown in the northeastern corner of California on older distribution maps (Sudworth, 1913; Munns, 1938; Little, 1949). The species is locally common in the southern Warner Mountains, and recent maps all record it there (Haller, 1962; Fowells, 1965; Critchfield and Little, 1966).

Pinus washoensis Mason & Stockwell. Washoe pine. This close relative of ponderosa pine is distributed along the western edge of the Great Basin in a few scattered localities from Lake Tahoe north. It enters the region that we are concerned with only in the Warner Mountains (Haller, 1961), where it intergrades with ponderosa pine. Haller, (1965) has suggested that hybridization between the Pacific and Rocky Mountain races of ponderosa pine may have played a role in the origin of this doubtfully distinct species.

Pinus ponderosa Laws. Ponderosa pine. One of the most wide-ranging trees in western North America, this species is unexpectedly absent from a large area in the center of its range, including nearly all of the northern Great Basin, northern Utah, southern and eastern Idaho, western Wyoming, and southwestern Montana. The many occurrences shown in this central region by Munns (1938) all appear to be in error. Baker and Korstian (1931) attributed this large gap in the range of ponderosa to a deficiency of moisture in the early part of the growing season.

The Rocky Mountain race of ponderosa pine (*P. ponderosa* var. *scopulorum* Engelm.) does not enter the region considered here, although it is present not far south in the mountains of eastern and southern Nevada (Billings, 1954; Little, 1956). The Pacific race extends east to the Warner Mountains and the Hart Mountain area of southern Oregon (Sargent, 1897; Sudworth, 1908). It is also present in northwestern Nevada in two localities that have not previously been reported.

One of these Nevada outliers (fig. 1K) is within a few miles of the ponderosa stands in and near the Warner Mountains. In the extreme northwestern corner of the state (41°59.5′ N Lat, 119°58.0′ W Long), a scattered stand of this species grows along Twenty-mile Creek at an elevation of about 5000 ft (BLM). It extends downstream a short distance into Oregon.

The other and much smaller outlier in northwestern Nevada is at least

20 miles from the nearest known ponderosa pine (fig. 1L). This grove, located on the west slope of Bald Mountain in the Sheldon National Antelope Refuge, was reported to us by O. V. Deming of the Fish and Wildlife Service, U. S. Department of the Interior (pers. comm.). It is growing at an elevation of 6500 ft at 41°50.0′ N Lat, 119°38.5′ W Long. It consists of one large tree (43 inches dbh, about 50 ft high) at least 300 years old, three smaller trees from 9 to 35 ft high and ranging in age up to about 70 years, and a large number of scrubby seedlings. Except for a few seedlings, the entire colony is confined to an outcropping of whitish rhyolitic sand which appears to be extremely infertile. The isolation of this grove and the distribution of tree ages suggest that all of the younger trees in the colony are descendants of the single old tree.

Discussion

The Pinaceae has a long history in the northern Great Basin. The four genera represented in this region today, *Abies, Picea, Pseudotsuga,* and *Pinus,* were present here 40 million years ago. All are elements of the Eocene flora of the Copper Basin, near the Jarbidge Mountains in northern Elko Co., Nevada (Axelrod, 1966). Several contemporary species are represented by closely similar fossil species in this conifer-rich flora: *Abies grandis* or *A. concolor* (*A. sonomensis* Axelrod), *Picea engelmannii* (*P. lahontense* MacGinitie), *Pseudotsuga menziesii* (*P. sonomensis* Dorf), *Pinus aristata* (?) (*P. crossii* Knowlton), and *P. ponderosa* (*P. harneyana* Chaney & Axelrod). During the ensuing Miocene epoch, several of these fossil species were also widespread on the Columbia Plateau north of the Great Basin (Chaney, 1959).

The highly discontinuous and sporadic distribution of the Pinaceae in this region today may have been influenced by events of the much more recent Pleistocene epoch. During Pleistocene times the climate of the Great Basin was periodically cooler and wetter than it is now, and these climatic cycles are widely believed to have caused major changes in plant distribution (Morrison, 1965). Lake Lahontan, a Pleistocene lake that covered much of northwestern Nevada during the pluvial periods, may have acted as a barrier to plant migration. The southern shoreline of the lake during the last pluvial period coincides rather closely with the present northern limits of *Pinus monophylla* (cf. Morrison, 1965, fig. 1; cf. Critchfield and Little, 1966, map 16). The northern arms of the lake, which extended to the Oregon border, may have restricted east-west migration. Cordilleran elements of the Pinaceae are confined to the region east of the lake. Their westernmost representative is *Pinus flexilis* in the Santa Rosa Range, just east of the Lake Lahontan shoreline. West of the shoreline, in northwestern Nevada, the outliers of the Pinaceae all have Pacific affinities with the possible exception of the *Pinus albicaulis* stand in the Pine Forest Range.

A lake the size of Lahontan could not have been more than a partial barrier to east-west migration across the Great Basin, however. It can-

not entirely account for evidences of long-term separation between eastern and western elements of the Pinaceae in this region. Four of the most widespread species considered here have U-shaped ranges that border the northern Great Basin on the east, north, and west. All four, *Abies concolor, Pseudotsuga menziesii, Pinus ponderosa,* and *Pinus contorta,* are differentiated into well-defined geographic races on opposite sides of the Great Basin. It is improbable that these races met without mixing during the pluvials, since the eastern and western races of *Pinus ponderosa* and of *Abies concolor* have proved to be highly compatible in crosses made at the Institute of Forest Genetics, Placerville, California. Nor is it likely that these races have evolved as recently as the last pluvial, which is estimated to have been about 20,000 years ago (Martin, 1963). Both the long generation interval of these trees and the geographic extent of their races argue against this possibility. The alternative is that the Great Basin long antedates the late Pleistocene as a barrier between Pacific and Cordilleran segments of these conifers.

This conclusion is hard to reconcile with recent evidence of drastic vertical and latitudinal plant migrations in the Great Basin and the Southwest during the late Pleistocene. This evidence, much of it from analyses of fossil pollen in the Southwest, has recently been reviewed by Martin and Mehringer (1965). It supports the view that the disjunct distributions of the montane conifers considered here are remnants of former continuous distribution across the intervening basins.

A different interpretation of comparable patterns of distribution has been advanced by Wells (1966) and Wells and Berger (1967). Their investigations of late-Pleistocene macrofossils preserved in wood rat middens in west Texas and the southern Great Basin have failed to uncover any evidence of substantial downward displacement of high-montane conifers during the last pluvial period. They attribute the disjunct and sporadic distribution of these species to long-distance transport of propagules, rather than former continuity. This view of Pleistocene vegetational history provides some support for our interpretation of the Great Basin as a long-term barrier in the evolutionary history of these coniferous species.

Two range extensions in this region have been reported since this article was prepared. S. A. Scott (FS) has collected *Pinus albicaulis* in the Jack Peak area (41°30′ N Lat), extending the range of this species to the Independence Mountains (*S. A. Scott,* 1967, IFGP). C. W. Ferguson of the University of Arizona has found an extensive stand of *Pinus aristata* near the summit of Pearl Peak in the Ruby Mountains (Deseret News, Salt Lake City, Utah; Dec. 12, 1968), 7–8 miles north of the stand on Sherman Mountain.

Pacific Southwest Forest and Range Experiment Station,
Forest Service, U. S. Department of Agriculture, Berkeley, California
University of California, Berkeley

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LAURA M. LORRAINE, 1904–1968

Roxana S. Ferris

To be a good botanical collector does not mean that one must be a professional botanist. The aesthetic enjoyment of seeing nature undisturbed and a desire to know something about the plants of meadows, streams and forests stimulated Laura Lorraine to collect flowers to satisfy this curiosity. During her college years at Stanford University, where she received her Bachelor's and Master's degrees in Romance Languages, she took a course on the classification of flowering plants with Dr. L. R. Abrams, a course designed for both botanical and non-botanical students. From this background of laboratory and field work, she acquired a most rewarding hobby.

Our many botanical excursions together were profitable as well as pleasant and extensive collections were added to the Dudley Herbarium at Stanford. The specimens were collected in Northern California or the Sierra Nevada. One of the pack trips in the Sierra yielded a new *Lewisia* —*Lewisia sierrae,* collected at the headwaters of the south fork of the San Joaquin.